would have done well had he made his reasoning a little more clear and detailed. The method adopted is the graphical method, a diagram being given for each machine, &c., considered. The diagrams are given without, in some cases, any of the reasoning which leads up to them. This to the engineer who thoroughly understands the subject does not matter, and to such we would recommend the book. Besides dealing with the general calculations concerned with single and polyphase motors, one chapter is devoted to the special design of a three-phase motor of 200 h.p.; and two chapters, the first and the last, deal with the theory of the alternating current transformer. In appendix ii. a graphical method is given for integrating some of the equations given in the body of the book. We think it is possible for this so-called "non-mathematical" treatment to be carried a little too far. The electrical engineer who does not wish to be severely handicapped in his profession must be able to work out an integration without having recourse to a roundabout method to avoid it, which is most likely only applicable to the particular case under consideration.

Bulletin of the Philosophical Society of Washington. Vol. xiii. 1895–1899. Pp. xxvi + 507. (Washington, D.C.: Judd and Detweiler, 1900.)

THE subjects of papers included in this volume are:—Central American rainfall, a transcontinental series of gravity measurements, cloud classifications, steel cylinders for gun construction, the latitude-variation tide, Alaska, graphic reduction of star places, chemistry in the United States, the transcontinental arc, a century of geography, the comparison of line and end standards, recent progress in geodesy, secular change in the direction of the terrestrial magnetic field at the earth's surface, and the function of criticism in the advancement of science. In addition, there are a number of obituary notices of members of the Society.

Several of the subjects of the papers have already been referred to in these columns, and as the papers go back to March 1895, it is a little late to describe them in any detail. The volume is of particular interest to students of geodesy and physical geography, the papers on the measurement of arcs for the determination of the size and shape of the earth, and on gravity observations, being full of information. The results of a series of gravity measurements, made by Mr. G. R. Putnam, lead to the conclusion that "general continental elevations are compensated by a deficiency of density in the matter below sea-level, but that local topographical irregularities, whether elevations or depressions, are not compensated for, but are maintained by the partial rigidity of the earth's crust." Gravity measurements made on the summit of Pike's Peak and at Colorado Springs, near the base, give the value 5·63 for the mean density of the earth. A discussion of Mr. Putnam's gravity observations leads Dr. C. K. Gilbert to agree that they "appear far more harmonious when the method of reduction postulates isostacy than when it postulates high rigidity."

At the close of a paper on the transcontinental arc measured by the U.S. Coast and Geodetic Survey, Mr. E. D. Preston refers to the accuracy of the observations, and remarks: "The quality of the triangulation is best shown by a comparison of bases. The Fire Island one, nearly 9 miles long, was determined in five different ways through 1800 miles of triangulation, and the extreme range of the results is only two-tenths of a metre. The value from Kent Island base, 5 miles long and 263 miles away, only differed from that given by the Atlanta base, nearly 6 miles long and 868 miles away, by one centimetre."

The paper on the secular change in the direction of the terrestrial magnetic field at the earth's surface, by Mr. G. W. Littlehales, contains a number of valuable plates showing curves of the secular motion of the magnetic needle for twenty-nine different places.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Theory of Temporary Stars.

IN a note read before the Royal Astronomical Society on May 10, Father Sidgreaves offers a suggestion regarding the displacement of the dark bands in the spectrum of Nova Persei which seems to obviate the serious difficulty felt by astrophysicists in the explanation of the shift of the lines on Doppler's principle.

The ingenious idea set forth in this note—emanating, apparently, from so high an authority as Lord Kelvin—certainly goes far to explain the singular fact that the displacement of these dark bands in the Novæ should *always* be towards the more refrangible side. But Father Sidgreaves remarks that the suggestion does not "help us over the second difficulty: the great breadth of the bright lines, some of which seemed to have lost nothing in width up to the last days of April." The following remarks may perhaps contribute towards an explanation of this second phenomenon, and may thus form a theory supplementary to that proposed in Father Sidgreaves' note.

First of all, it ought to be remarked that the structure of the bright bands, when seen with high dispersion, is extremely complicated. In Nova Aurigæ, as well as in the present new star, the bands were observed to consist of several bright maxima separated by darker interstices. Sir Norman Lockyer, in his communication to the Royal Society on March 28, presented some exceedingly interesting diagrams, exhibiting the intensity curves of the bright hydrogen bands in Nova Persei. Sir Norman shows that these bands consisted of at least three, and in the case of H_β of even four, maxima. The very same structure appears in the chief nebula band at $\lambda = 501$, as is

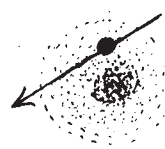

FIG. 1.

shown by the measurements made with the Cooke spectroscope of this Observatory, an account of which will shortly be published.

In the note referred to, Sir Norman Lockyer has already suggested that we have here "indications of possible rotations or spiral movements of two distinct sets of particles, travelling with velocities of 500 and 100 miles per second." It appears, therefore, that the extreme width of the bright bands is not caused by a continuous broadening of the line—such as, for instance, increased pressure would produce—but by the juxtaposition of several lines belonging to the same substance, but of somewhat different wave-lengths owing to motions in the line of sight. An explanation of the width of the bright bands is thus equivalent to giving a sufficient reason for the production of displacements such as would conduce to the peculiar grouping of the maxima in the bright lines of the spectrum of new stars.

Father Sidgreaves starts from the assumption of "a collision between two stars." We shall here proceed from the hypothesis propounded by Prof. Seeliger, of Munich, that the Nova is due to the phenomenon of a dark body impinging upon and penetrating into a mass of nebular material.

Now it seems extremely unlikely that the density of the matter composing the nebula should be the same throughout. There will in all probability be a condensation of this matter round the centre, or centres, of gravity of the mass, so that the density must be assumed to decrease outwards from this centre. I consider an assumption of this kind to be warranted, if not demanded, by our modern views regarding the evolutions of stellar systems. But if a body flying through space should approach such a mass, the probability is very small that its line of motion would pass directly through the centre of gravity. Hence we are fairly warranted in assuming that the path of the body through the nebula will lie somewhere between its centre and its boundary (Fig. 1).

In such a case the friction on the surface of the body, caused by its motion through the resisting medium must be greater on the side next the centre of the nebula than on the side next its boundary. This difference of resistance must obviously result in imparting to the impinging body a rotatory movement.

Of course a tremendous translatory velocity would be required to produce any sensible motion of rotation in the impinging body itself. But by following Prof. Seeliger's reasoning it becomes easy to understand how even a comparatively small translatory motion suffices to originate enormous gyratory movements in the strata of the atmosphere surrounding the body. Obviously, the immediate consequence of a collision between body and nebula will be a superficial heating of the former and the resulting formation of an incandescent atmosphere around it. Now Prof. Seeliger has pointed out that the attraction of the body on the nebular mass through which it travels must greatly enhance the relative velocity of those particles which pass near the surface. In his opinion, "no extravagant assumption is required to obtain very great velocities for these particles, velocities such as have been proved to exist in the case of Nova Aurigæ." Hence, even when the initial translatory motion is small, the attractive force of the body would cause enormous differences of velocity between the impinging particles of the cosmical cloud and the atmosphere of the intruding body. And

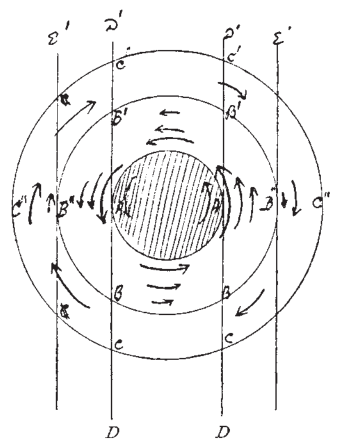

FIG. 2.

it is easy to perceive that, in case of a preponderance of impacts on one side over those on others, there must result a gyratory movement of the atmosphere, the velocity of which will, in course of time, become much of the same order as that of the impinging nebular matter.

The assumption of a cosmical cloud, the density of which increases towards the centre of gravity, leads, therefore, to the necessary conclusion that the incandescent gaseous matter near the body must assume a vorticose motion of probably very high velocity. This motion has its maximum near the surface of the body, whence it will grow less with increasing distance from the centre.

According to the fundamental laws of gyration the rotatory motion must vanish at a certain distance, beyond which it will assume the opposite direction. Let Fig. 2 represent a section through the centre of the vortex in a plane perpendicular to its axis of rotation. Let AA be the surface of the body, BB the locus of the stationary sphere separating the two oppositely-gyrating systems, CC the outermost boundary of the whole system of gyration. Then we have between A and B a rotatory motion of high velocity in *one* direction, decreasing in amount from A towards B, and a rotatory motion in the opposite direction between B and C of less average velocity than the former. The space from A to C is filled with incandescent nebulous matter, the maximum incandescence being at A, whence it decreases towards C. The space beyond C, on the other hand, is filled with nebulous matter of low temperature and no rotatory motion.

The whole vortex travels, of course, along with the central body in a certain direction. This obviously imparts to the light emitted by *every* particle of the whole system exactly the *same* displacement, and hence the motion of translation may be left out of consideration in questions dealing with *relative* velocities.

The assumption made so far, that the rotation of the particles takes place in circles concentric with the circumference of the body, must, however, be modified. The fan-like action of the body's atmosphere will draw in towards the poles of rotation quantities of nebulous matter which, yielding to centrifugal force, will flow towards the equator, and be thence projected outwards again. The nature of this action may best be seen by considering a section of the system in a plane passing through the centre of the vortex and in the direction of the axis of rotation. The figure so obtained (Fig. 3) is precisely the same as that arrived at by Dr. Siemens in his ingenious theory of the conservation of solar energy. (NATURE, March 9, 1882.) In fact, the conditions postulated by Dr. Siemens in his theory—viz that the sun is surrounded by matter in a rarefied form, filling interplanetary and even interstellar space—are precisely the conditions under which the phenomenon of a new star is here supposed to occur.

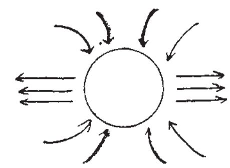

FIG. 3.

We have, then, to expect an indraught of cool nebulous matter at the poles of the intruding body, and an outflow in all directions of hot nebulous matter at its equator.

In spite of the apparent complexity of the different motions involved in the gyration here described, it is comparatively easy to indicate the influence they must have on the appearance of the lines of a substance present in the nebular matter. Let us first consider the influence of the *tangential* components of the gyratory motion.

Reverting to Fig. 2, and assuming AD to be the direction of the line of sight, it is clear that in the space AADD we have to deal with an incandescent nucleus AA whose light is intercepted by incandescent matter at a lower temperature between A and C, and by dark nebulous matter of still lower temperature between C and D. The resultant effect would be exactly that which Sir William Abney has described in *M. N.* xxxvii. p. 278. The displacements of the line in opposite directions from the normal caused by the approach and recession of the limbs of the rotating body and its atmosphere would broaden the absorption band, which would therefore appear dark in the centre and would gradually shade off towards the edges. The intensity curve of

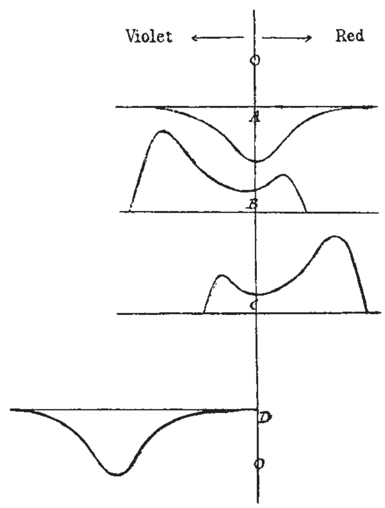

FIG. 4.

the band produced by this part of the gaseous envelope, still provided there be no *radial* motion of matter in the vortex, would thus be similar to that exhibited in curve A in Fig. 4.

Taking next the segment BAB′B″ on the left hand side of the

figure, we have a motion of the incandescent nebulous matter *towards* us. We must therefore expect a bright line displaced towards the violet. The maximum intensity of this line will be near the edge farthest from the normal position, and it will gradually dim off in brightness as the normal wave-length is approached. This dimming off, which is chiefly the consequence of decreasing incandescence with decreasing rotatory motion, is enhanced by the absorbing action of the cool substance in the outer rings of the vortex. For this matter, having no motion with a direction *towards* us, can absorb only those wave-lengths which coincide with its own, viz. those emanating from the incandescent matter at and near the arc BB″B′, while it leaves the light of higher wave-lengths emanating from A unaffected.

If we now consider the conditions prevailing in the annular section BCC″C′B′, we see at once that the motion of the particles is here in the opposite direction, viz. away from the earth. The light emanating from these particles will, therefore, be displaced towards the red, and consequently a bright line must appear on the less refrangible side. But the velocity of motion in the line of sight in this annular section is smaller than at A, and the incandescence of the particles much inferior; hence the maximum intensity of this new line will not be so far from the normal wave-length, and the line will also be fainter than that on the violet side described before. Taking into consideration these circumstances, we may then assume that the intensity curve resulting from the whole radiation in the segment C′C″CA on the left hand side of Fig. 2 is approximately represented by the curve B in Fig. 4. The radiation of the corresponding segment on the right hand side of Fig. 2 must obviously be the image of B in the normal OO′, and is thus represented by C of Fig. 4.

As all the light emanating from the star must be supposed to pass through the slit of the spectroscope, the line seen in the spectrum will be the resultant of all the component curves. Clearly the character of this compound line remains unaltered, whatever position the line of sight may have with reference to the motion of the star or to the axis of gyration, except the one case when the line of sight is parallel to this axis. Obviously the band would then be reduced to a single line at normal wave-length. The probability of such an occurrence is, however, excessively small. Hence the theory here advanced would lead us to accept the peculiar character of the bright lines exhibited in the curves B and C of Fig. 4 as *a feature characteristic of the whole class of temporary stars.*

So far we have traced the structure of the line emitted by a substance of the nebulous matter on the assumption of circular rotatory movements. We have still, however, to take into account the influence of the flow of this matter to and from the centre of the vortex, as indicated in Fig. 3.

The cool matter flowing in at the poles of the vortex must be supposed to be in a non-luminous condition. It can neither radiate nor absorb selectively in the way as Kirchhoff's law would require, and hence it has no effect on the structure and position of the bright and dark bands. The hot and incandescent matter flowing out at the equator, however, has an important influence in this respect. Reverting to Fig. 2, it may be readily seen that the radial component of the motion of the gaseous particles within the space A A D D included between the two tangents to the surface of the body is directed *towards* the sun. Consequently the absorption bands caused by these particles must all appear displaced towards the violet. Thus, instead of curve A in Fig. 4, which represents the intensity of these bands when there is no radial motion, we obtain curve D of the same figure as the actual representation of the intensity of these bands in the spectrum. The striking difference between A and D is therefore the considerable displacement towards the more refrangible side of the absorption band in D. No matter what direction the line of sight has with regard to the motion of body or nebula, or whether we consider a section through the vortex at right or oblique angle to the axis of gyration, in all cases, except the one mentioned above, *the displacement of the absorption bands must be towards the more refrangible side.* The effect of the radial components of the gyratory motion on the position of the bright bands is easily seen from a consideration of the conditions prevailing in the segments C C″ C′ A in Fig. 2. Apparently there are as many motions towards as there are away from the sun. Hence the effect will consist in a general broadening of the four maxima represented in B and C of Fig. 4, without, however, affecting their position relatively to the normal wave-length.

The combination of B, C and D in Fig. 4 will therefore approximately represent the complete intensity-curve of a line emitted by a substance in the gaseous envelope of the Nova. The combination of B and C alone represents the structure of the bright bands; it agrees perfectly with the drawing given by Sir Norman Lockyer for the case of H_β. Often enough the two inner maxima may overlap each other and thus produce the impression of a single strong maximum at normal wave-length. This would explain the curves with only three maxima exhibited in the diagrams of Sir Norman's paper.

There can be no doubt that the absorption band in D will partly interfere with the maximum of the emission band on the violet side. As a rule the former may be assumed to be the more refrangible, since its displacement must be enhanced by the expansion of body and vortex as a consequence of increased production of heat. In the case of Nova Persei, the difference in the displacement owing to this latter effect must have been very considerable; the two bands were here placed beside each other with comparatively little encroachment of the one upon the other. The conditions in Nova Aurigæ appear to have been somewhat different. Here the displacements of the emission and absorption bands seem to have been fairly equal, the latter obliterating the former almost completely. I consider the bright lines noticed in almost all the absorption-bands of this Nova to be the remnants of the more refrangible maxima of the bright bands.

In any case the effect of a partial encroachment of the absorption band upon the emission band must be a displacement of the centre of the bright band towards the red. We therefore derive two most important results from the theoretical considerations here given:—

(1) *In all the temporary stars the absorption bands must be displaced towards the more refrangible side.*

(2) *In all the temporary stars the centres of the emission bands must show displacements towards the less refrangible side.*

These conclusions are in entire accordance with the facts. As already mentioned, an exception may happen when the line of sight is approximately parallel to the axis of gyration. In this case both the emission and absorption lines would appear in their normal positions, since all the vortex-motions are then more or less perpendicular to the line of vision. Hence the two lines would overlap each other almost completely, and the result would be a purely continuous spectrum with little or no traces of selective absorption or emission. Such an exceptional case many perhaps have presented itself to our eyes in Nova Andromedæ.

The new star in Perseus, thanks to its discovery by Dr. Anderson almost immediately after its appearance in the heavens, offered to astronomical science the unique opportunity of recording the initial stages of its development. None of the theories hitherto propounded have so far succeeded in accounting for the spectral changes so markedly exhibited in the star's light during the first days of its existence as a radiating celestial body. But just these quite unexpected and at first sight perplexing changes find a marvellously simple explanation by the modification of Prof. Seeliger's nebular theory here offered. The first effect of the collision between the dark body and a cosmical cloud must be an enormous heating of the body's surface and the generation of an incandescent atmosphere around it. The depth of this "cloak" of incandescent matter will at first be small, so that the star at that time presents the aspect of a luminous nucleus surrounded by a comparatively shallow atmosphere of incandescent gases. The spectrum yielded by such a star must be continuous, showing dark lines generated by the absorbing faculty of the glowing gases between the nucleus and space. At the moment of the outburst these dark lines will be exceedingly faint, and they will show only such a displacement as is necessary from the amount and direction of the translatory motion of the body. As time passes, however, and the gyration of the atmosphere becomes stronger, the outward flow of the hot particles must rapidly increase, and thus, in accordance with the developments given above, the dark lines, while becoming broader and more distinct, must gradually shift towards the more refrangible side. This increase in the displacement of the dark bands during the first days has been actually observed by Prof. Vogel and many other spectroscopists. To yield a *bright* line spectrum the incandescent atmosphere must have attained a considerable depth, otherwise the bright lines emanating from particles in the space CC″C′A would make no

marked impression on the vividly luminous continuous background. Hence we conclude that the bright bands can only appear with sufficient distinctness when the gyratory motion has attained considerable velocity. This is exactly the sequence of the phenomena observed immediately after the outburst.

In the beginning the attracted nebular particles will impinge directly on the surface of the dark body, and hence the heat developed will mainly serve to raise the temperature of this surface. But after gyration has set in, the direct contact between the outside nebula and the body's surface is greatly lessened by the interference of the vortex. The attracted particles will then impinge upon the vortex-rings by which many of them are deflected into circular orbits and thus prevented from colliding with the surface. It is therefore conceivable that the incandescence of the nucleus, after having attained a maximum very soon after the collision, decreases again when the vortex motion gains in power. After a time, the incandescence of the nucleus will be chiefly maintained by the friction between the vortex and the surface. The star's radiation must therefore ultimately attain a lower limit where it becomes stationary so long as the vortex motion is constant. This state appears to have been reached by Nova Persei towards the middle of March.

The variability of the star is a natural consequence of this theory. We have only to suppose that the dark body, when entering the cosmical cloud, had no sensible rotation of its own. In this case the impacts would be more frequent, and consequently the incandescence more vivid, on one part of its surface than on others. Now, when the gyratory motion has become considerable, the friction between vortex and body must gradually impart a slow rotatory movement to the latter. Thus, by rotation, the patch of greater luminosity would at times be revealed to us, while at other times it would become invisible.

In conclusion I shall mention a fact revealed by the observations which speaks greatly in favour of the theoretical views set forth in this paper. Whenever the continuous spectrum of the Nova became feeble, the green band at $\lambda = 501$ was seen to gain considerably in breadth and brightness. Now a reduction of the intensity of the continuous background must obviously be accompanied by a decrease in the intensity of the absorption bands. If the nucleus were to lose its radiating power altogether, these bands would naturally become emission bands. In such a case the bright bands of the spectrum would therefore appear much broader and more intense. Hence any reduction in the general emissive power of the nucleus must tend to increase the width and brightness of the spectral lines.

That the spectrum gradually changes from the chromospheric to the nebular type is exactly what must be expected from the foregoing considerations. I need scarcely say that the theory is sufficiently flexible to adapt itself to any kind of hypothesis which may be made with regard to the physical constitution of the nebular matter. Considering the enormous forces which must have been developed in the impacts, I incline to the opinion that, besides a gaseous fluid, we are probably here in presence of cosmical matter of a meteoritic constituency such as Sir Norman Lockyer assumes in his well-known theory.

I am fully aware that the explanations I have been able to give in this communication can only be a first approach to the comprehension of a phenomenon which is necessarily one of extreme complexity. Considering, however, that the theory here advanced is based upon assumptions which seem to me perfectly warranted and highly probable, and that the prominent facts brought out by the spectroscope are satisfactorily explained by it, I venture to submit it even in this preliminary state to the criticism of astronomers. It is certainly the first time that the ingenious theory of Dr. Siemens has been called upon to explain a phenomenon in the remote recesses of the universe, and I am confident there must be many admirers of this eminent man of science who would wish to find his excellent theory applicable to the extraordinary case of stellar evolution before us.[1]

My best thanks are due to Mr. G. Clark, of this Observatory, for several suggestions which proved to be most valuable for the above investigation.

J. HALM.

Royal Observatory, Edinburgh, June.

[1] It is worthy of remark that a terrestrial cyclone, if the velocities therein exhibited were vastly greater than they actually are, and if its centre were occupied by a radiating nucleus so hot as to make the gyrating gases incandescent, would present to an outside observer exactly the same structure in the bands of its spectrum as is exhibited in the case of Nova Persei.

Vitality of Seeds.

THE resistance of the dormant protoplasm of seeds to low temperatures has lately received much attention. C. de Candolle, Pictet, Brown and Escombe and Sir W. T. Thiselton-Dyer have in succession extended our knowledge of the resistance of seeds towards extremely low temperatures. The last-mentioned experimenter has shown that very various seeds do not lose their germinating power after being exposed to the temperature of liquid hydrogen.

The upper limit of temperature which seeds can resist does not seem to have been carefully ascertained. It is probable that it would vary with different seeds and for the same seed when containing different percentages of water. For it is known that the coagulating point of proteid depends, within certain limits, on the amount of water present in it. Thus Lewith (*Arch. für exp. Pathol. u. Pharmak.* 1890) showed that proteid containing 25 per cent. of water coagulates at 74°–80° C., containing 18 per cent. at 80°–90° C., and with 6 per cent. only at 145° C. It follows that if it is the coagulation by heat of the proteids of the seed which prevents the embryo returning from its state of suspended animation into active vitality, the resistance of the seed will depend on its state of desiccation.

With this idea I have been making a few preliminary experiments on desiccated seeds, and I find that in every case they can resist surprisingly high temperatures. At first I thought it necessary to desiccate the seeds over sulphuric acid for a fortnight or longer before raising their temperature considerably. I now find it as effective, and more convenient, to dry the seeds on an oven for a day at 65°–75° C., and then for a day at 90° C. After this they may be raised to successively higher temperatures without harming them till their upper limit is passed. All the seeds I have tested can resist a temperature of at least 100° C. The following are the species I experimented with :—*Avena sativa*, *Lolium perenne*, *Lactuca sativa*, *Helianthus argophyllus*, *Mimulus moschatus*, *Medicago sativa*, *Brassica Rapa*, *Eschscholtzia californica*, *Papaver somniferum*, *P. nudicaule*, *Meconopsis cambrica*, *Schizopetalon Walkeri*.

Of these Medicago has proved the most resistant. After an exposure of one hour to 110° C. and then of one hour to 121° C., 10 per cent. germinated.

The effect of exposure to the high temperature is, however, noticeable in all cases by the marked retardation of germination and by the extremely slow growth afterwards. The young plants, too, seem weakly, and there is a distinct loss of sensibility to the geotropic stimulus in their radicles. Whether they would ultimately become normal I cannot say, as the conditions under which they were germinated were not suitable for further development.

For most of the other seeds the upper limit seems to be considerably lower. It lies about 110° C. Perhaps, however, by more careful desiccation even these less resistant ones may be brought into a condition to stand exposure to higher temperatures. The following table will convey some idea of these preliminary experiments, showing the upper limit and the retarding effect of exposure to high temperatures for each species.

The Roman numerals indicate the number of days between moistening and germination as indicated by the protrusion of the radicle.

Temperatures	15°	97°	100°	105°	107°	108°	110°	112°	114°
Avena sativa	iii	vi	v	iv	—	—	xi	—	—
Lolium perenne	v	iv	iv	v	xii	—	xii	—	—
Lactuca sativa	ii	ii	ii	ii	vi	—	viii	xii	xviii
Helianthus argophyllus ...	iv	iii	iii	iv	xi	—	xi	—	—
Brassica Rapa	ii	ii	—	iii	vi	vi	viii	—	—
Eschscholtzia californica...	ii	iii	ii	ii	ii	—	vii	—	—
Mimulus moschatus ..	—	vii	ix	xviii	—	—	—	—	—

From this table the increase in the time needed for germination is apparent. All the samples of seeds were sown on moist sand simultaneously, and maintained under conditions of temperature and moisture as similar as possible.

For the other seeds not mentioned in this table the time needed for germination was not recorded, and only the maximum temperature resisted was observed. These maxima were as follows : *Schizopetalon Walkeri*, 105° ; *Papaver somniferum*, 100° ; *P. nudicaule*, 100° ; *Meconopsis cambrica*, 100° ; *Medicago sativa*, 121°.

This great resistance of dried seeds to comparatively high